LENTIL PRODUCTION IN WESTERN CANADA

FarmFacts

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The lentil, one of the oldest cultivated crops, was first grown in southwest Asia. The lentil is best adapted to the cooler temperate zones of the world. FAO statistics indicate that lentil is grown on about 1.7 million ha each year and total production exceeds 1.0 million t. India is the leading lentil-producing nation, accounting for over half the world's supply, but most of their production is consumed domestically.

There are two types of lentil: The Chilean or large-seeded (100 seed weight of about 7 g) and the Persian or small-seeded (100 seed weight of about 4 g). Seed coat color may vary from light green to deep purple blotched or black. Cotyledon color may be yellow, red or green. The predominant type grown in western Canada is Chilean (large-seeded) with yellow cotyledons.

Commercial production of lentil in North America first started in 1937 in the Palouse area of eastern Washington and northern Idaho. This area currently produces lentil on 40,000 to 50,000 ha per year.

Field scale production of lentil in western Canada began in 1970 when 600 ha were grown in the Eatonia district of west-central Saskatchewan. Production increased to a high of 6,000 ha in 1972, decreased to about 400 ha in 1975 and 1976, and increased to about 240,000 ha in 1987. Most of the Canadian lentil crop is produced in Saskatchewan, but Manitoba and Alberta also produce lentil crops. The average yield has been about 1000 kg/ha.

Low wheat quotas and active contracting were primarily responsible for the increased acreage in 1970 to 1972. Increased wheat quotas, unfavorable weather at seeding time, absence of any registered herbicides and lack of supporting agronomic research combined to result in low levels of production in 1975 and 1976. However, agronomic research results are now available, several herbicides have been registered for lentil and several other herbicides are in the process of being registered. These facts indicate that lentil production will be continued in western Canada.

Market Opportunities

The primary use of lentil is for human food; dry pea and fababean are higher yielding and provide more economical livestock food. Lentil is used largely as a protein source in soups, stews and in vegetarian dishes.

Most lentil seeds are consumed in the same nation in which they are produced, except for Turkey and North America. However, there is an increasing export trade in lentil. Canada is now the second largest lentil exporting country. In addition, the small domestic market for lentil in Canada is gradually increasing. Even so, the farmer is advised to obtain a contract for marketing his lentil crop. Several firms offer contracts, sometimes specifying a minimum guaranteed price.

Adaptation

Lentil is a cool season crop with a restricted root system and is only moderately resistant to high temperature and drought. It is best adapted to the Dark Brown soil zone, but can be grown in the southern part of the Black soil zone if seeded early. Excellent lentil crops have also been grown in the Brown soil zone when seeded on fallow. The lentil plant has an indeterminate (continuous) flowering habit and some drought stress or nitrogen stress is needed in the latter part of the flowering process in order to facilitate maturation of the younger pods. Because crops following lentil in the rotation generally yield higher than crops grown after cereals or flax, lentil may be used to extend the rotation in these areas.

Seedbed Preparation /Seeding

Firm, weed-free seedbeds on well-drained, high fertility soils are best for lentil production. Stony fields should be avoided or packed after seeding

to bury loose stones that otherwise might be picked up during swathing and harvesting.

Plant lentil seeds 3 to 8 cm deep in rows 15 cm apart as early in the spring as possible, provided the temperature of the surface 3 cm of soil is above 5°C and the soil is not excessively wet. Lentil seedlings can withstand considerable frost. Even if the frost is severe enough to kill the main shoot, the lentil plant will initiate regrowth from axillary buds at one of the nodes at or below the soil surface. However, maturity will be delayed.

Seeding is usually done with an ordinary grain drill, but the discer is perfectly satisfactory. If the discer is used, the soil should be packed immediately after seeding to prevent excess moisture loss. Tine harrows help smooth the field surface and facilitate close swathing.

Seeding rate depends on seed size. The optimum seeding rate is about 20 seeds per m of row in rows 15 cm apart. This averages about 45 kg/ha for the small-seeded (Persian-type) Eston, 70 kg/ha for common Chilean (large-seeded) lentil, and 90 kg/ha for the extra-large seeded Laird.

Early Seeding

Lentil plants continue flowering and setting seed until growth is terminated by some factor of the environment such as drought, heat stress, frost or nitrogen deficiency. Early seeding (before May 15) is preferred, but lentil can be successfully grown most years if seeded before May 25. Eston may be seeded as late as June 10, but yield will be reduced.

Early seeding increases the height and size of the plant at time of first bloom. Consequently, the lowermost pods are farther above the ground, the entire plant is taller, the yield is higher, and swathing is facilitated.

Stubble vs. Fallow Crop

Since lentil has an indeterminate growth habit, it continues to grow until restricted by the environment. Highly fertile soils, such as fallow fields high in NO_3-N, will result in excess vegetative growth at the expense of seed production, if growth is not restricted by drought or high temperatures. Cereals will respond better than lentil on highly fertile fallow fields. Lentil may be grown successfully on stubble land in the moister parts of the Dark Brown soil zone, if weeds are properly controlled. Lentil is a preferred choice for a stubble crop in heavy clay soils. On lighter soil, soils low in NO_3-N, or in the Brown soil zone, lentil may be grown on fallow land.

Varieties

Until 1980 most of the Canadian lentil crop was seeded to the unregistered Chilean type. Since then, most of the Saskatchewan production has switched to the variety Laird. Laird is an extra-large-seeded (Chilean-type) variety and is later maturing, which further emphasizes the importance of early seeding. It produces a tall (for lentil), upright plant that facilitates swathing. Laird has an intermediate level of resistance to ascochyta blight.

A second variety is Eston, a small-seeded (Persian-type) lentil. It is short and early maturing. However, it has a short, bushy growth habit, making it fairly easy to swath, unless it is hail damaged or drought stressed. Eston is susceptible to ascochyta blight.

Seed Treatment and Inoculation

Lentil seeds germinate and emerge extremely rapidly and thus fungicide seed treatment is not normally used.

Inoculation of lentil seed with the lentil strain of *Rhizobium leguminosarum* will assure that the lentil plants fix part of their nitrogen requirement. The rhizobia infect the root hairs of the germinating seed and induce nodule formation. These nodules are the site of nitrogen fixation. Maximum benefit is derived if a well-nodulated lentil crop has not been grown previously in the field and the supply of soil NO_3-N is low. It may not be necessary to inoculate the seed after two high-yielding, well-nodulated lentil crops have been grown in a field, since the rhizobia are capable of remaining viable in the soil for many years.

The inoculum may be applied to dry seed in a slurry of inoculum and sticker solution and mixed thoroughly just prior to seeding. The use of a sticking agent such as corn syrup (a dilute solution), milk or powdered milk in solution will increase the amount of inoculum sticking to the seed. A garden sprayer or a thoroughly cleaned herbicide tank with a hose and nozzle attached to the outlet may be used to apply the sticker solution to the seed. The inoculum may then be metered into a grain auger, which does a good job of mixing the inoculum with the sticky seed, provided it is operated slowly at about half capacity. The inoculated seed should be kept out of the sun and seeded soon after inoculation, since the bacteria will not tolerate sunlight or prolonged drying. Wet seeds may "bridge" in the drill box and should dry 1-2 hours before being placed in the drill box. A new dry sticker is available and its use avoids the mess of using wet stickers, but it is more expensive.

All inoculum is dated to assure high viability of the bacteria. Purchase fresh inoculum specific for lentil and store in a cool place until used.

For more details see Saskatchewan Agriculture publication **Legume Inoculation.**

Fertilizers

Nitrogen is necessary for high yields of lentil, but generally it need not be applied. The nitrogen-fixing *Rhizobium* symbiotically fixes up to 40 percent of the nitrogen in the lentil plant and the rest is obtained from the soil. Stubble fields testing less than 30 kg N/ha will benefit from the application of 30 kg N/ha, but not

with the seed.

Phosphorus is required in relatively large amounts. Rates of phosphate (P_2O_5) should not exceed 30 kg/ha (50 lbs/a of 11-55-0) applied with the seed. Rates should be based on a soil test.

Weed Control Practices

Successfully limiting weed competition represents one of the most important steps in profitable lentil production. Because this crop is relatively short and lacks the ability to form a dense canopy even under ideal growing conditions, most common annual grass and broadleaf weed species can compete effectively with lentil any time throughout the growing season. However, competitive effects are particularly significant during establishment of the lentil crop and during periods when low soil moisture limits growth. Lentil should NOT be grown on land where perennial broad-leaved weeds are a problem, as chemical control is not possible. Volunteer grains can become a serious weed problem when stubble cropping, particularly following a dry autumn. Seed yield losses caused by infestations of both grass (Table 1) and broadleaf weeds generally range from 25% to 75% of potential lentil yield. These losses are generally greater than for other field crops, particularly under low weed densities. Weeds such as Russian thistle and kochia that germinate late in the season offer severe competition to podding lentils, interfere with swathing and increase dockage and moisture levels in the harvested seed.

A. Cultural Weed Control:

Cultural weed control generally produces highly variable results, with the level of weed control achieved primarily dependent upon environmental conditions and stage of weed growth. Postemergent harrowing is relatively ineffective as a means of controlling any weeds except for germinating broadleaf seedlings, and frequently causes excessive crop damage. In contrast, one or two preemergent harrowing operations with a tine harrow following seeding will firm and groom the seedbed and improve the kill of winter annuals only partially uprooted by seeding and tillage operations. Appropriate weed control during summerfallow years, careful selection of a clean seedbed, inclusion of a shallow tillage operation in problem areas prior to seeding, and use of clean seed are important procedures worth considering when planning lentil production.

B. Chemical Weed Control:

Currently, several herbicides are registered for weed control in lentil. Although these chemicals control a number of the common weeds, producers should check carefully to ensure control of specific weed problems anticipated on an individual farm basis. Note that elimination of only some weed species may permit other species to dominate the weed spectrum and, in turn, effectively outcompete the seedling lentil plants. For example, elimination of wild mustard and wild oat allows such weeds as green foxtail, redroot pigweed and cow cockle to flourish in this short, open crop. Products are not available to provide adequate control of perennial thistles. A grower must develop a long-term approach to weed control by effectively manipulating rotations and herbicides (particularly in spring cereals where a wide range of chemicals is available) in order to effectively reduce weed populations during other parts of the cropping sequence.

Stubble cropping may necessitate sacrificing small areas of the crop to permit spot treatment with glyphosate (ROUNDUP) in areas of dense thistle and quackgrass stands. Application of glyphosate using a rope wick has provided promising results for in-season suppression of annual grasses and thistles by wiping the chemical on the weed canopy above the lentil crop. Avoid drift from phenoxies such as MCPA and 2,4-D, since lentil is very sensitive to these products. Thorough product knowledge and accurate application are essential for maximizing herbicide benefit. Observe detailed instructions included on the label because only a brief outline documenting herbicide use is presented in this section. Note that rates are expressed as amount of commercial product per hectare and per acre.

Lentil is sensitive to herbicides and some injury can be expected from the use of most herbicides. During periods of environmental stress (extreme heat or drought) crop tolerance can be improved by increasing water volumes and spraying during the evening.

Fields treated with the commercial mixture of picloram plus 2,4-D (TORDON 202C) should NOT be seeded to lentil for at least 5 years. Carryover of picloram may necessitate seeding an indicator area to lentil 1 year prior to commercial cropping as a test for residual activity. Symptoms of picloram injury include an upward cupping of the leaves, reduced or stunted growth and failure of the plants to pod and set seed.

Crop damage can result when fields containing soil residues of herbicides such as **GLEAN, ALLY** and **ASSERT** are seeded to lentil. Check product labels carefully for re-cropping restrictions and field bioassay techniques. Fields treated with **LONTREL** should not be seeded to lentil in the year following treatment.

Because yield losses from any given weed density are much greater in lentil than for cereal or oilseed crops, it makes good economic sense to spend limited herbicide resources in lentil as marginal returns are greater.

The following herbicides are registered for weed control in lentil in Saskatchewan.

Fenoxaprop-ethyl (EXCEL) controls annual grass weeds in the 1-6 leaf stage (including tillers) and volunteer barley in the 3-6 leaf stage (including tillers). Best results are obtained when the weeds are small and

Table 1
The Effect of Wild Oat Density on Lentil Yield (Crop Development Centre, Saskatoon)

Wild Oat Density		Lentil Yield	
#/ft²	(#/m²)	lb/ac	(kg/ha)
0	0	2000	2240
3	32	1145	1285
7	75	965	1080
11	118	785	880
14	151	520	585

actively growing. Apply a rate of 2.5 L/ha (1.0 L/ac) in 100 L of water/ha (40 L/ac) at 275 kPa. Allow an interval of at least 4 days between the use of Excel and any other pesticide.

Diclofop methyl (HOE-GRASS) provides post-emergent control of wild oat, green and yellow foxtail, and barnyard grass in the 1- to 4-leaf stage, and Persian darnel in the 1- to 3-leaf stage. Apply HOE-GRASS 284 at 2.5 L/ha (1.0 L/ac) in 100 L of water/ha (40 L/ac) at 275 kPa. Spray nozzles directed at a 45 degree forward angle will provide optimum spray coverage of this translocated herbicide. Treatment must take place before tillering of the grass weeds. Optimum control and crop yield can be expected if the herbicide is applied when the majority of the grass weeds are in the 2- to 3-leaf stage. Herbicides for the control of broadleaf weeds must not be applied until at least 4 days after application of diclofop methyl. Do not apply diclofop methyl if rain is expected within 1 hour after application.

Metribuzin (SENCOR) provides early postemergent control of crucifers (mustards, non-triazine tolerant volunteer rapeseed and stinkweed) in addition to other broadleaf weeds, including lamb's-quarters, tartary buckwheat, smartweed, corn spurry, chickweed and hemp nettle. Apply SENCOR 75 DF at 0.275 kg/ha (0.11 kg/ac) or SENCOR 500 at 0.425 L/ha (0.17 L/ac)at 275 kPa in a minimum of 100 L of water/ha (40 L/ac) as an overall spray when the lentil plants are at the 2-5 node stage and the weeds are small. Lentil seeds must be planted at least 5 cm below the soil surface to prevent phytotoxicity from leaching after heavy rainfall. Do not apply for 5 days after frost or if rainfall is expected within 6 hours, and allow a 5-day interval between application of metribuzin and other pesticides. Do not apply metribuzin more than once per crop season. High temperatures or frost after application may cause temporary yellowing and delayed growth. Do not use in soils with less than 4% organic matter. Continuous agitation is required to prevent settling.

Sethoxydim (POAST) at 0.8 L/ha (0.32 L/ac) for control of green and yellow foxtail, barnyard grass and Persian darnel (use 1.0 L/ha (0.4 L/ac) for extremely heavy infestations of the above annual grasses);
At 1.4 L/ha (0.57 L/ac) for wild oat;
At 1.6 L/ha (0.65 L/ac) for extremely heavy infestations of wild oat;
At I.4 L/ha (0.57 L/ac) + BASF Power Pack* or at 1.6 L/ha (0.65 L/ac) for volunteer wheat, volunteer oat and volunteer barley;
At 1.9 L/ha (0.77 L/ac) for extremely heavy infestations of volunteer cereals.
At 2.7 L/ha (1.08 L/ac) + BASF Power Pack* or at 4.4 L/ha (1.76 L/ac) for top-growth control of quackgrass.

Apply post-emergence in 50-100 L/ha (20-40 L/ac) of water at a minimum 240 kPa (35 psi) pressure when annual grasses are in the 1-6 leaf stage (best control will be obtained from the 2-5 leaf stage). Treat quackgrass when it has 1-3 leaves. The crop is tolerant at all stages of growth. Use 0.5-1.0 L/ha (0.2-0.4 L/ac) of Assist Oil Concentrate for annual grasses and 2.0 L/ha (0.8 L/ac) of Assist for quackgrass. Higher application pressure and Assist rates are required for dense weed infestations, especially at the later leaf stages.

Allow 4 days before application of any other pesticide. Avoid spray drift to cereal and grass crops.

*BASF Power Pack contains 2 x 10.6 L of liquid ammonium sulphate and 1 x 3.4 L of Assist Oil Concentrate. One case of Poast with 2 Power Packs treats 24.7 ac at the Volunteer Cereals rate. One case of Poast with 1 Power Pack treats 12.8 ac at the Quackgrass rate.

Trifluralin (RIVAL, TREFLAN) is registered only as a fall application. Apply TREFLAN 545 liquid at 2.0 to 2.6 L/ha (0.8-1 L/ac) or 5% granule at 22 to 28 kg/ha (8.9-11.3 kg/ac or RIVAL 500 liquid at 2.2 to 2.8 L/ha (0.9-1.1 L/ac) or 10% granule at 11 to 14 kg/ha (4.5-5.7 kg/ac). Rate is dependent upon soil type and organic matter. Deep-soil incorporate to 10 cm in fall for control of annual grasses (wild oat, green and yellow foxtail and barnyard grass) plus several annual broadleaf weeds (lamb's-quarters, redroot pigweed, wild buckwheat, chickweed and cow cockle). Incorporate within 8 hours using a vibrashank or tandem disc. Two operations in the fall at right angles are required. The seedbed should be tilled 5-8 cm just prior to seeding in order to activate the chemical.

Non-registered compounds should not be used since the liability and responsibility falls completely upon the grower in the event of crop damage, inadequate weed control or herbicide residues in the seed.

For additional information on weed control in lentil contact:

Crop Development Centre, University of Saskatchewan
A. Slinkard — 966-4978
R. Holm — 966-5006

Saskatchewan Agriculture
Weed Control Specialist — 787-4673
Special Crops Agronomist — 787-4665

CAUTION - ALWAYS READ AND FOLLOW LABEL INSTRUCTIONS WHEN USING HERBICIDES.

Insect Pests

Grasshoppers - Grasshoppers do not like to eat lentil plants, except newly emerged seedlings. However, they will chew off all or part of the flower buds, thus preventing seed production. Damaged buds will have the petals and some of the green pointed sepals surrounding the base of the petals chewed off. If grasshoppers are a problem in other crops, they should also be checked for and sprayed in lentil crops, as they can prevent seed production. The result is a beautiful green field with few seed pods. Grasshoppers can be controlled by spraying with deltamethrin (DECIS Flowable).

Ground application: Apply 80-120 mL/ha (32-48 mL/ac) in 100-200 L water/ha (40-80 L/ac) when grasshoppers are in the 2-4 nymphal stage. Best control will be achieved when application is made prior to wing development. Under severe grasshopper pressure, application should also be made to fence rows and to a 15 m strip around the lentil field, but DO NOT APPLY TO UNREGISTERED CROPS. Leave a 15 m border around wetlands, houses and other environmentally sensitive areas. DO NOT TREAT FIELDS WITHIN 40 DAYS OF HARVEST.

Aerial application: Apply 80-120 mL/ha (32-48 mL/ac) in 11-22 L water/ha (4.4-8.8 L/ac) at a pressure of no less than 200 kPa. Leave a 100 m buffer zone around wetlands, houses and other environmentally sensitive areas. Deltamethrin is very toxic to aquatic organisms and fish, and drift into wetlands must be avoided. AVOID APPLICATION DURING TEMPERATURE INVERSIONS OR DURING PERIODS OF EXCESS HEAT. Best control will be attained by spraying during the cooler portions of the day. DO NOT APPLY MORE THAN 2 TIMES PER YEAR BY AIR OR MORE THAN 3 TIMES BY ANY METHOD. DO NOT GRAZE TREATED FIELDS.

Cutworms - Cutworms may be numerous enough to require spraying in certain fields.

Disease Problems

Diseases have not been very serious on lentil in western Canada, with a few exceptions. Soil-borne root rots may become serious in individual fields. Normally, individual plants become infected and die at various stages during the growing season, but this presents no problem. More serious situations occur where small areas scattered throughout the field ripen prematurely, due to death of the roots from root rot infection. Crop rotation with cereal crops, such that lentil, pea or fababean crops are grown in a given field no oftener than once every 4 to 5 years, will delay build-up of root rot in the lentil crop.

Ascochyta blight is the most serious disease of lentil in western Canada. It occurs on leaves, stems, pods and seeds and may become serious if the maturing pods and seeds are subjected to prolonged wet weather during July and August. Eston and common Chilean are susceptible to ascochyta blight. Laird has a moderate level of resistance, but this resistance breaks down as the plant matures. Thus, seed of all varieties will become severely infected if the swath is rained on intermittently for three weeks. Severely infected seed lots may not be saleable or will be docked severely due to discoloured seeds.

Producers should get all seed tested for seed-borne ascochyta (3 official laboratories are available) and use only the best lots for seed. Ascochyta inoculum also overwinters on lentil stubble, so producers are warned not to plant lentil on lentil stubble.

White mold, caused by *Sclerotinia*, may occasionally occur under high fertility conditions following a prolonged rainy period in July. The high fertility conditions, in the absence of heat or drought stress, promote excess vegetative growth which lodges to form a dense vegetative mat. Prolonged rainy weather promotes rapid growth and spread of white mold on the vines lying on the moist soil under this vegetative mat.

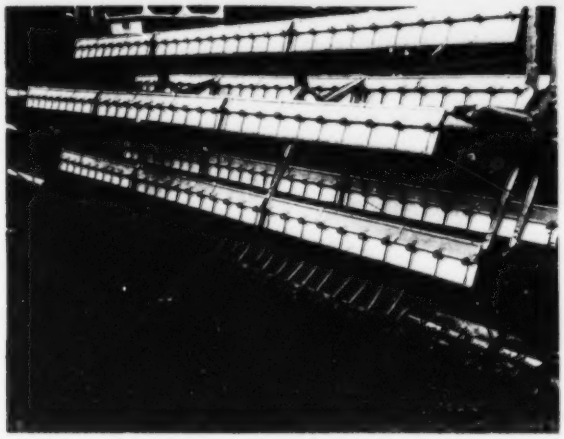
Flooding of a portion of the field during the growing season will result in death of the plants, since they cannot tolerate much flooding. However, this is not due to a disease organism.

Harvesting

Lentil plants have an indeterminate growth habit and continue producing new flowers and immature pods until stopped by stress due to heat, drought or low nitrogen. Lentil pods shatter readily and must be swathed when the earliest pods turn light brown and rattle. Shattering may be reduced by swathing at night when the higher humidity helps toughen the pods. The light fluffy lentil swaths are easily blown by wind the first day or so after swathing, but quickly settle, unless wild mustard or Russian thistle plants are present in large numbers.

Extreme care must be taken in harvesting the lentil crop. The vines often are only 20 to 40 cm tall, so the swather must be operated as low to the ground as possible. Swathers with a relatively short table are preferred, as they cut closer to the ground on uneven land. A swather equipped with a floating cutter bar and pick-up reel will do the best job. However, many farmers have done a satisfactory job of swathing with forage swathers or grain swathers equipped with a pick-up reel and operated slowly or only in one direction. Adjustable-height wheels at the sides of the cutter bar will aid in maintaining a more even cutting height and speed up swathing. A quick-cut knife facilitates cutting of the lentil plants also. Half-moon vine-lifters on the guards also help in cutting of lodged lentil plants. The cutter bar on the swather will occasionally gum up from the sap in the lentil stems. A light rinse in soapy water will reduce this gum temporarily.

As an alternative to swathing, lentil crops can be **desiccated** with REGLONE at normal swathing time. Ground application is recommended but aerial application may be used where the stand is too dense or the ground too soft for ground rigs. Applications rates are as follows:



Ground Application: Use 225-550 L of water/ha (90-220 L/ac). For normal crop canopy with few weeds, apply 1.5-2.0 L of product/ha (0.6-0.8 L/ac). For a very dense crop canopy or a weedy crop, apply 2.0 L/ha (0.8 L/ac).

Aerial Application: Reglone should be applied in at least 45 L of water/ha (18 L/ac). For sparse, non-uniform crops, use 1.5 L/ha (0.6 L/ac). Fields with a normal, full canopy and few weeds should receive 2.0 L/ha (0.8 L/ac). Very dense crop canopies or weedy crops should be treated with 2.75 L/ha (1.1 L/ac). Aerial application should not be used for fields where wetlands or other good wildlife cover might be oversprayed.

Reglone should always be mixed with Agral 90 at a rate of 1 L per 1000 L of spray mixture.

It should be noted that the use of a desiccant such as Reglone does not speed up maturity of the crop so treatment should not be made until the crop is mature (normal swathing time). Use of a desiccant to burn off crop foliage and weeds can reduce the time from maturity to harvest and reduce harvesting problems.

Lentil plants normally are ready to thresh about one week after swathing. However, if the swath becomes too dry the stems break into small pieces some of which remain with the seed. Excessively dry seed will chip and split badly during threshing. It may be preferable to thresh them at about 18-20% moisture and dry them down to 14% for safe storage.

In dry years, Eston lentil may be combined directly, since it does not shatter its seed readily. A floating cutter bar and a pick-up reel are best for direct combining.

Low cylinder speeds are required to reduce seed chipping and splitting during combining. Cylinder speeds of 350 to 600 r.p.m. are normally used, depending on cylinder diameter and moisture content of the lentil seeds. Special care must be taken to avoid chipping or nicking the edge of the flat seeds, since this greatly reduces seed quality. Combine augers and grain loaders should be operated at low speeds to reduce chipped, cracked, split and broken seeds.

Lentil seed containing green weed seeds or other high moisture materials should be cleaned as soon as possible to prevent heating. Moisture levels up to about 14% are considered safe for lentil. Lentil seeds with a moisture content of 14.1 to 16.0 percent are graded "Tough" and those over 16 percent are graded "Damp." If drying is necessary, do not exceed a maximum air temperature of 50°C (122°F).

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Revised October, 1989

6M 01/90 ISSN 0840-9447